Advances in Intelligent Platform Management: Introducing the New IPMI v2.0 Specifications

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Special Guests!

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Agenda

- IPMI Architecture and Initiative Update
- What's New in IPMI v2.0?
- IPMI v2.0 Technology: How it meets platform management needs
- IPMI in Action
- IPMI Futures

IPMI

Intelligent Platform Management Interface

- **Defines a standardized, abstracted, message-based interface to intelligent platform management hardware**
- **Defines standardized records for describing platform management devices and their characteristics**

Promoters: Intel, Hewlett-Packard, NEC, Dell

Adopters: 162 and growing

IPMI Enables Cross-Platform Management Software

Initiative News

IPMI v2.0 Specifications
Updated v1.5 Errata, 32- and 64-bit Drivers,
& IPMI Conformance Test Suite

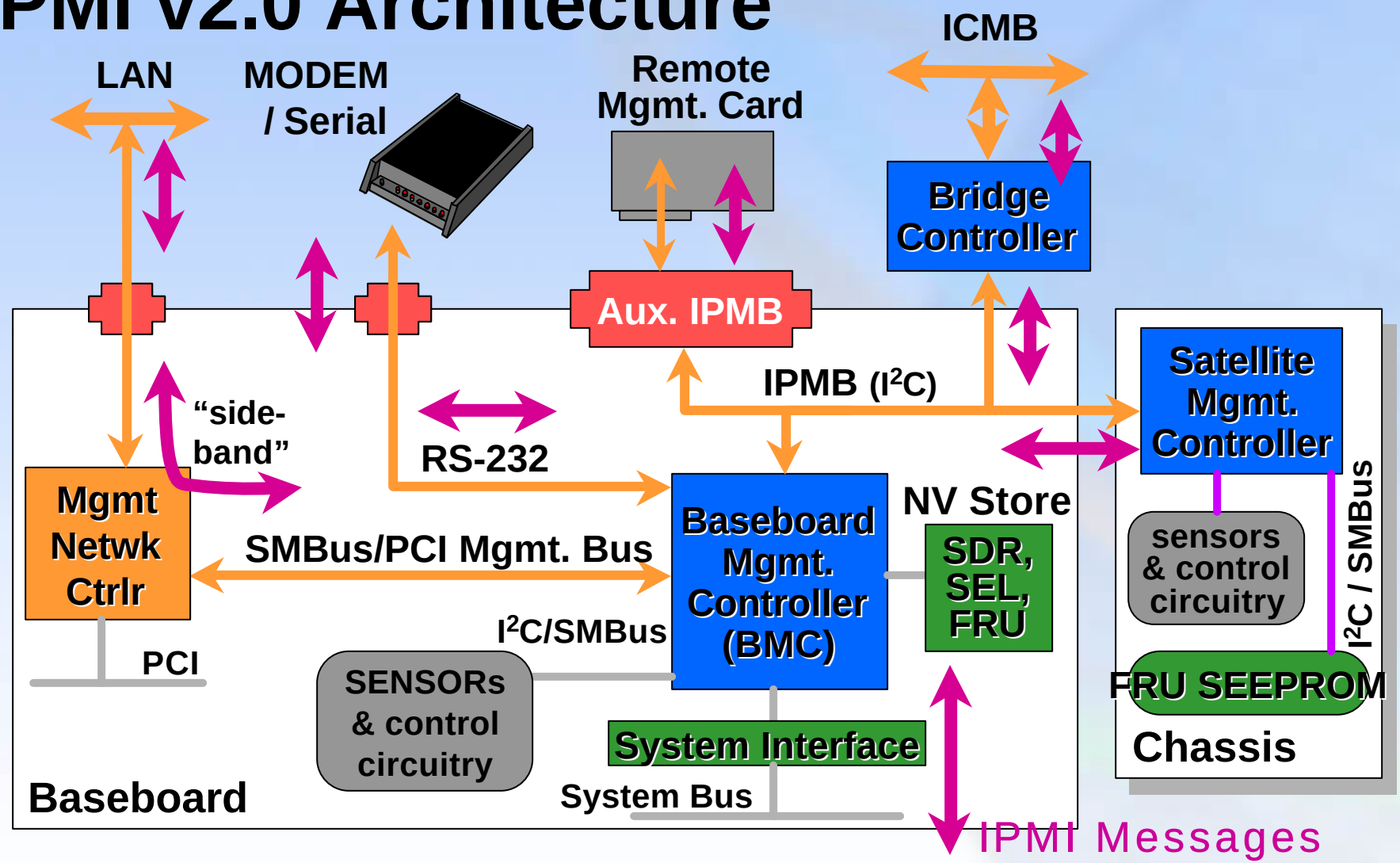
developer.intel.com/design/servers/ipmi

New Adopter's Agreement

- **IPMI v2.0 Second Generation Specification is under RAND (Reasonable And Non-Discriminatory) licensing model**
  - Aligns with Industry standards licensing models (e.g. DMTF*, PICMG*, Infiniband*, etc.)
- **All companies (including existing IPMI 1.5 adopters) will need to sign new IPMI v2.0 adopters agreement to implement IPMI v2.0 spec**
  - Existing IPMI 1.5 adopters can continue to implement IPMI v1.5 under old licensing terms, but to new IPMI v2.0 agreement required to implement new IPMI v2.0 features
- **New IPMI v2.0 Adopters license available on IPMI web site for your review**

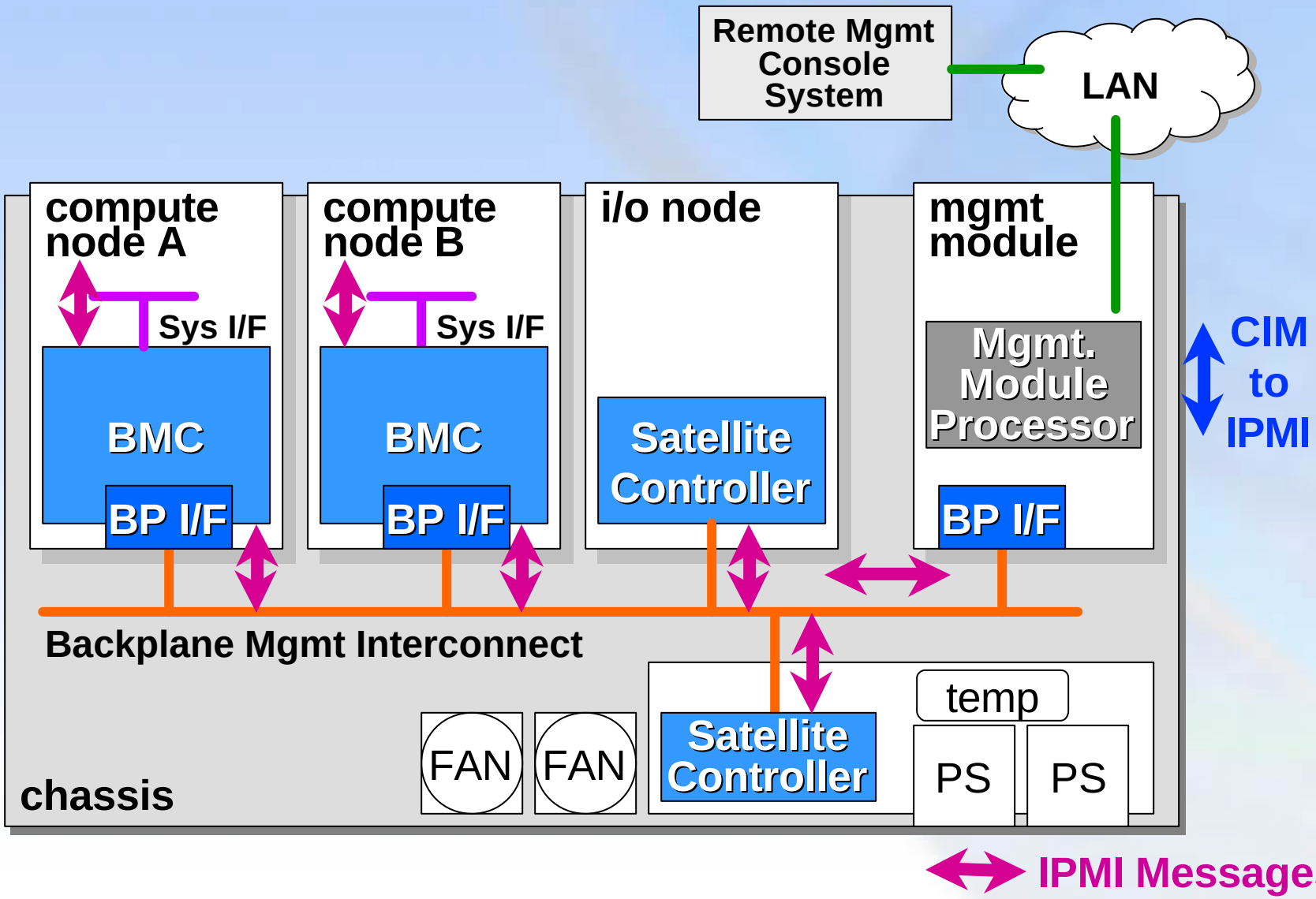
Sign Up as IPMI 2.0 Adopter Today!

IPMI v2.0 Architecture

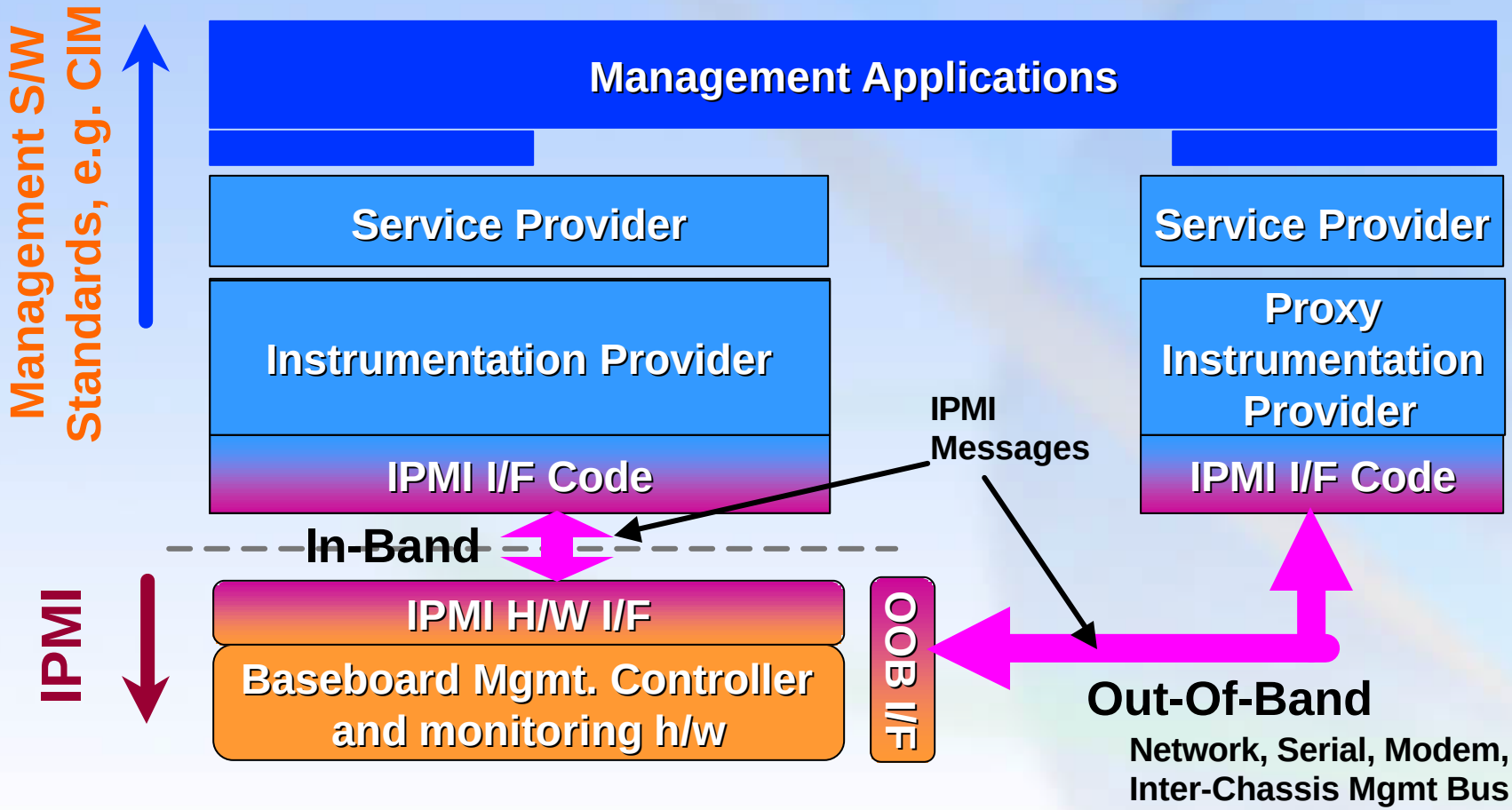


IPMI in modular architecture

Typical Modular Application



Where it fits…



IPMI helps reduce TTM and development cost for cross-platform management

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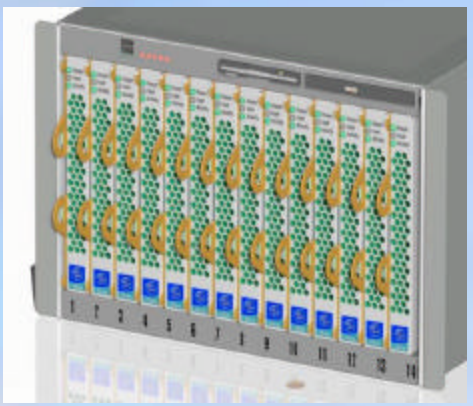
Platform Directions for IPMI

- Integrated 'Serial over LAN' management
- Low Cost Systems
  - "Baseline" BMCs
- Group Managed Systems
  - ICMB and LAN-managed systems
- Modular Systems
  - General purpose and Service Availability Forum "AdvancedTCA" blade systems



IPMI enables competitive features across server classes

IPMI v2.0 Additions

- Serial Over LAN (SOL)
  - Redirects local serial interface over an IPMI Session
  - Works with serial-based OS ‘command line’ interfaces
- LAN Session Enhancements
  - New user login and security configuration options enable tailoring security and performance to match the needs of the site
  - “Payloads” capability enables multiple types of management traffic (e.g. IPMI and SOL) over a single LAN session
- Enhanced Authentication
  - Stronger key exchange uses two-way challenge/response
  - Aligns with DMTF ASF 2.0* session establishment
- Packet Data Encryption
  - Enables remote operations such as user password configuration
- VLAN Support
  - Facilitates setting up ‘management-only’ networks

IPMI v2.0 Additions

- **Low-cost BMC Support**
  - **SMBus System Interface (SSIF) provides low-pin count system interface for low-cost (low pin-count) BMCs**
- **Modular Extensions**
  - **Node replacement, Redundant Management Bus monitoring, "Firmware Firewall" tailor IPMI to better support blade implementations**
- **Enhanced OEM value-added feature support**
  - **Support for OEM Security Algorithms and Payload options (e.g. KVM) on IPMI infrastructure**

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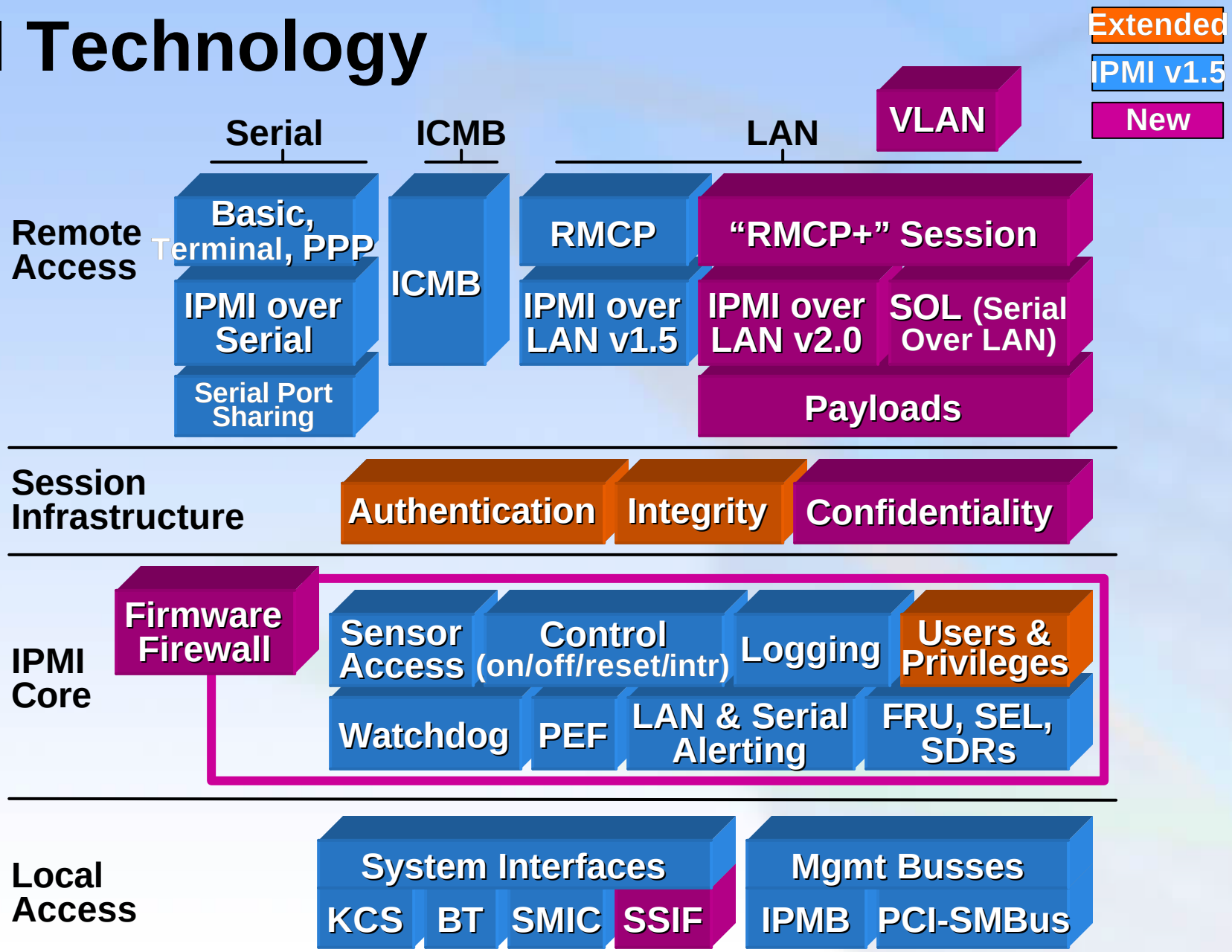
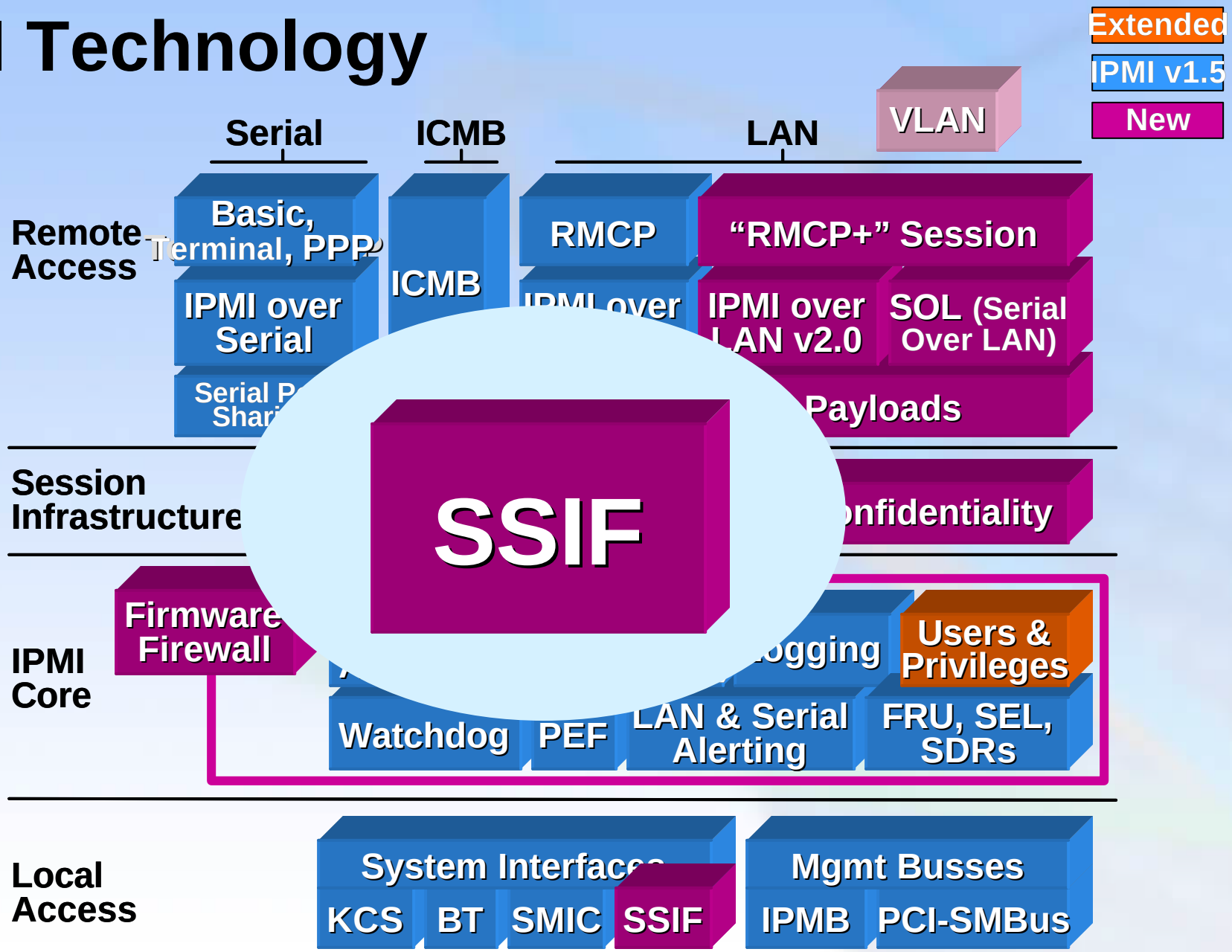
IPMI Technology



IPMI Technology



SMBus System Interface (SSIF)

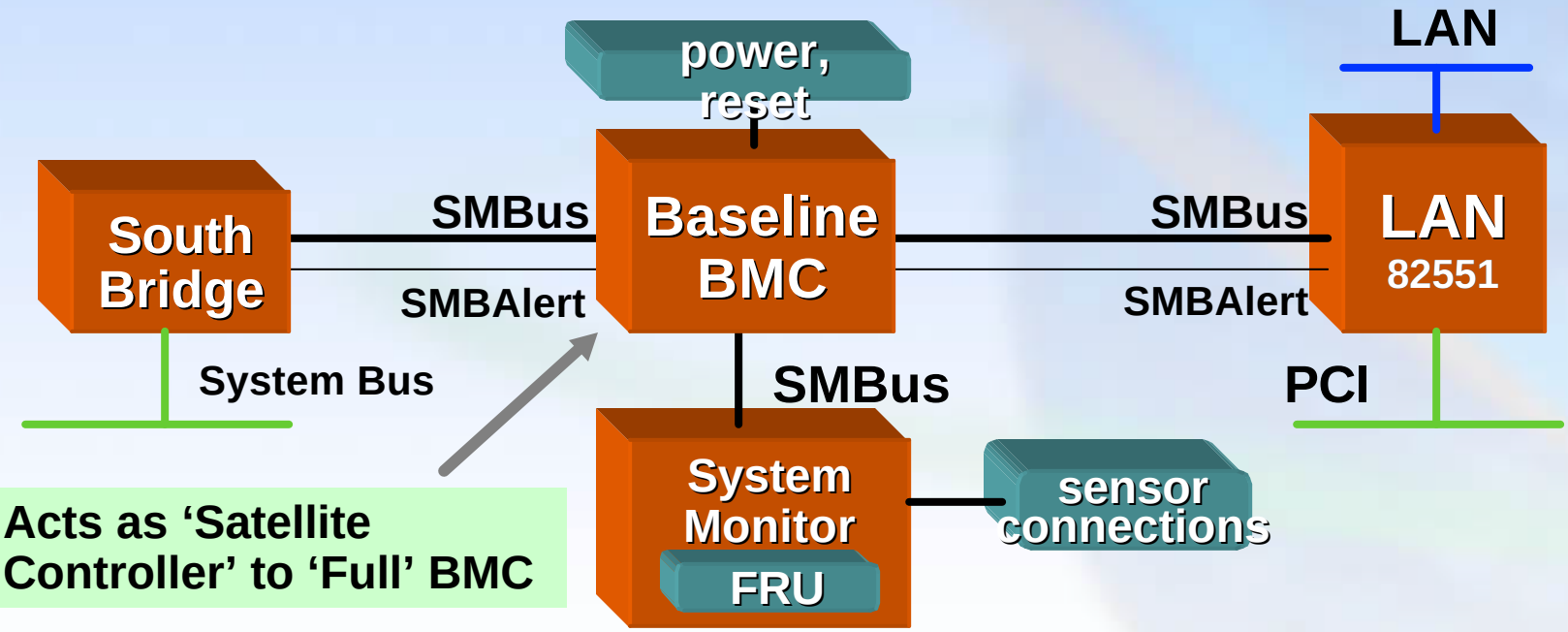
- Encapsulates IPMI messages in an SMBus compatible format
  - Compatible with common SMBus Host controllers
  - IPMI Requests delivered using ‘Block Write’ protocol
  - IPMI Responses retrieved using ‘Block Read’ protocol
    - SMBAlert signal status change/message available
- SMBAlert line notifies host that incoming message / status data is available
    - ‘Get Status’ command allows interface status to be polled

SMBus System Interface (SSIF)

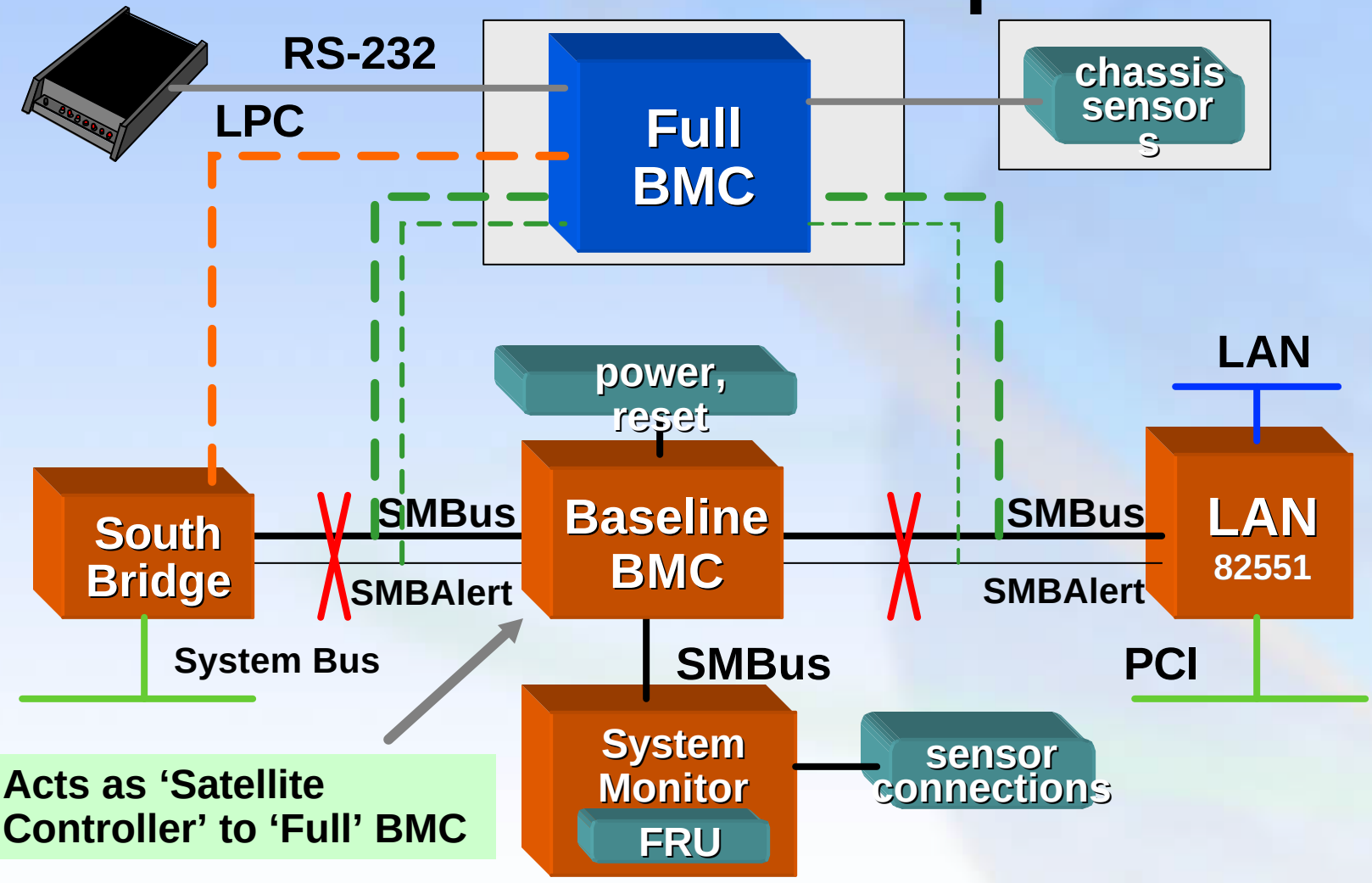
Local (System Interface) Discovery

- BIOS tables describe location and type of system interface
  - New ACPI “SPMI” (service processor mgmt. interface) Table
  - SMBIOS Type 38 Record
- SPMI and Type 38 Tables Applicable to *all* IPMI System Interfaces
  - SMIC, KCS, BT, SSIF

SSIF and Multi-level BMC Options



SSIF and Multi-level BMC Options



Low Cost Options enable IPMI for all Server classes

SMBus System Interface (SSIF)

Single Part Messages

- Used for IPMI Message Content up to 32 bytes (SMBus protocols limited to 32-bytes of data)

BMC Write / Request
(via SMBus Block Write)

WR
- BMC Slave Addr. | Wr
- SMBus CMD = *0x02*
- Length
  - IPMI NetFn (even) | LUN
  - IPMI Command
  - <IPMI Command Data>

BMC Read / Response
(via SMBus Block Read)

WR
- BMC Slave Addr. | Wr.
- SMBus CMD = *0x03*
- BMC Slave Address | Rd.

RD
- Length
  - IPMI NetFn (odd) | LUN
  - IPMI Command
  - IPMI Completion Code
  - <IPMI Command Data>

IPMI Message Content

SMBus System Interface (SSIF)

Multi-part Messages

- **Used for IPMI Message Content >32 bytes**
- **Block numbers enable retrieving lost or corrupted middle or 'end' read data**

BMC Multi-part Write / Request

(follows single part format for Start, but uses special SMBus CMDs for start and transferring remaining data)

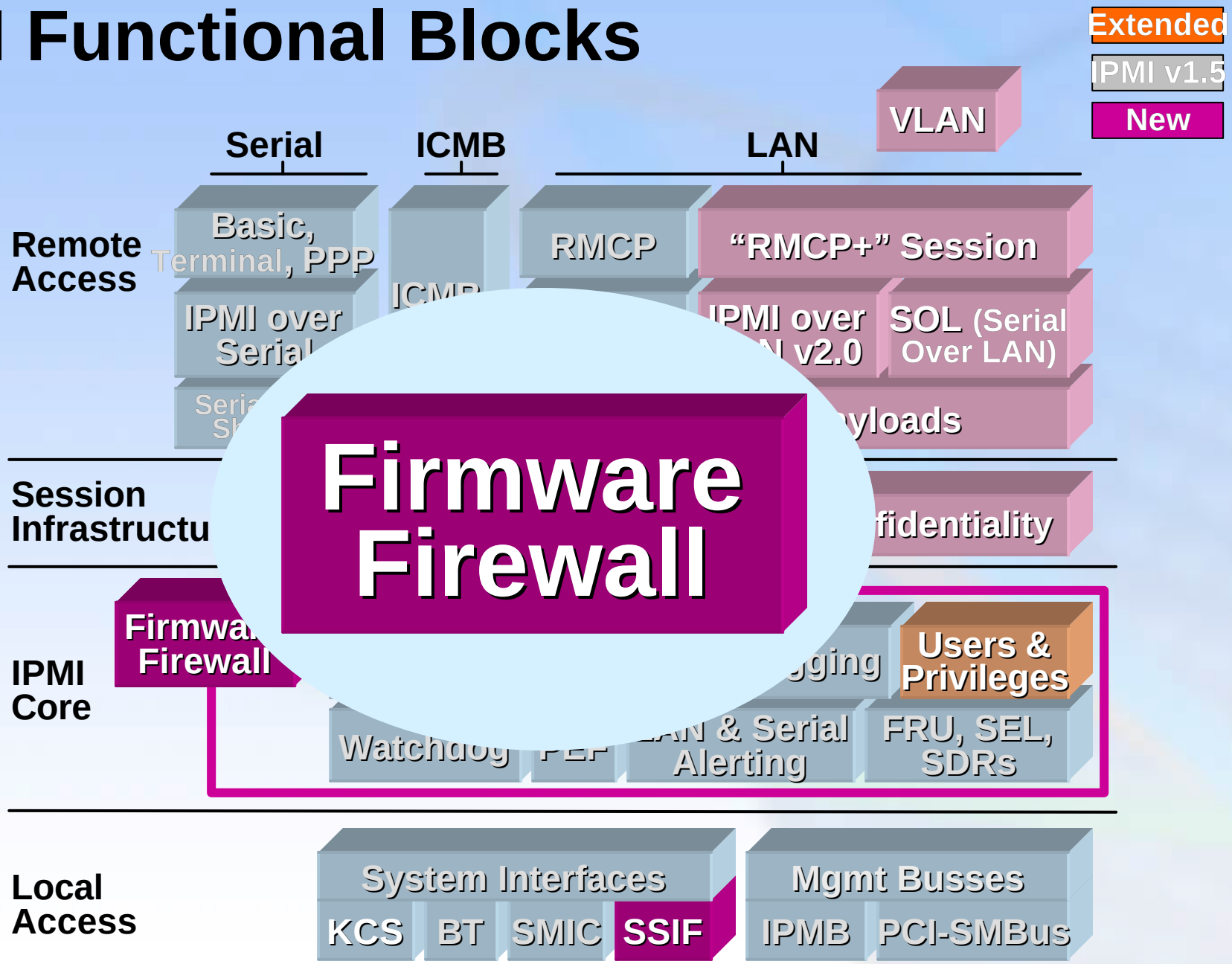
- **Start: SMBus CMD = 0x06, remainder matches single part format**
- **Middle: SMBus CMD = 0x07, followed by add'l request data**
- **End: SMBus CMD = 0x08, followed by last part of data**

BMC Multi-part Read / Response

(Starts off with reserved pattern [0x01, 0x00] then uses special SMBus commands to retrieve remaining data)

- **Start: SMBus CMD = 0x03, followed by [0x01, 0x00] then regular response data (NetFn | LUN, CMD, etc.)**
- **Middle: SMBus CMD = *0x09*, First byte = 00b followed by add'l response data**
- **End: SMBus CMD = *0x09*, First byte = 01b, followed by last part of data**

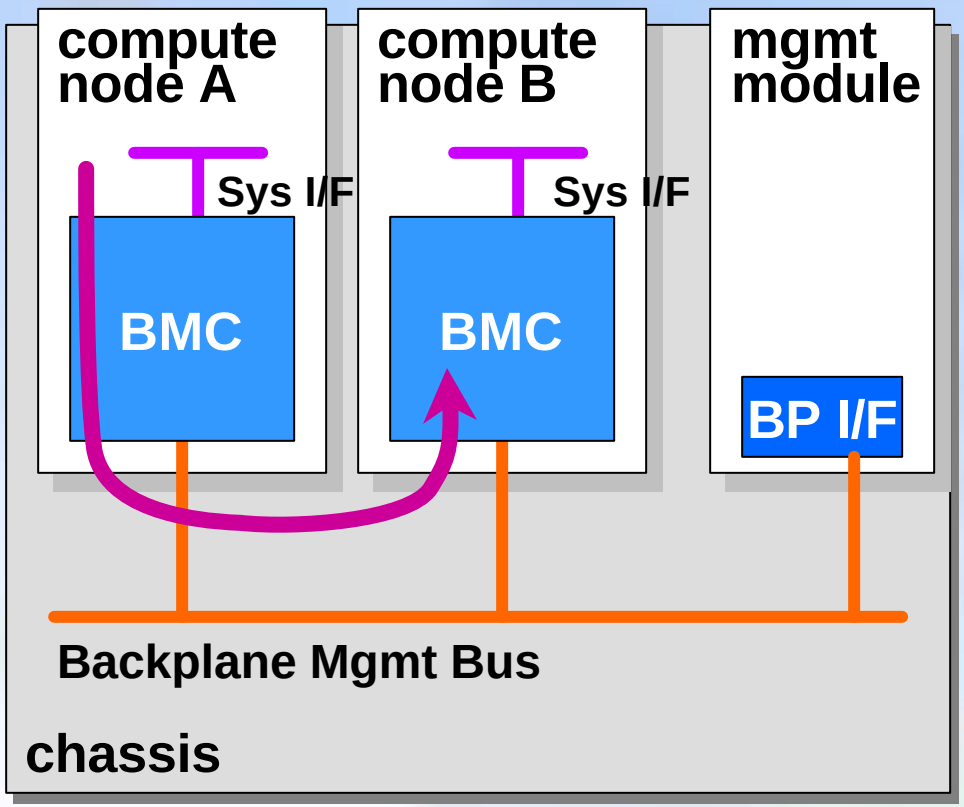
IPMI Functional Blocks



Firmware Firewall

Partitioning for protection

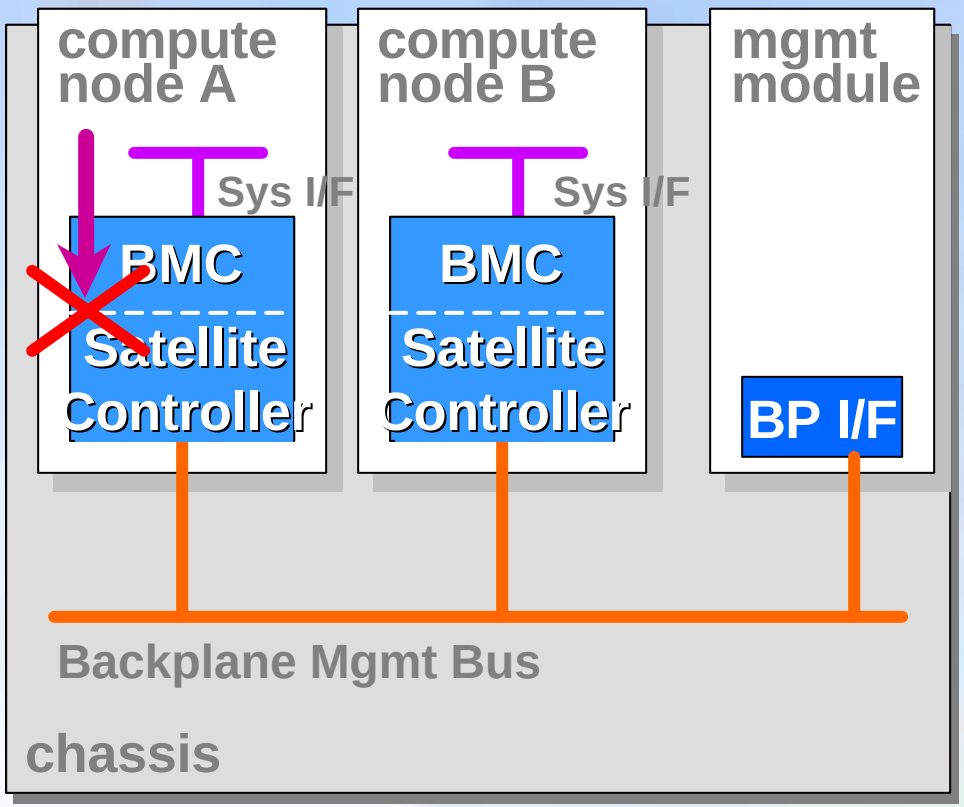
- **Problem: Bus topology enables local mgmt s/w to access other nodes**



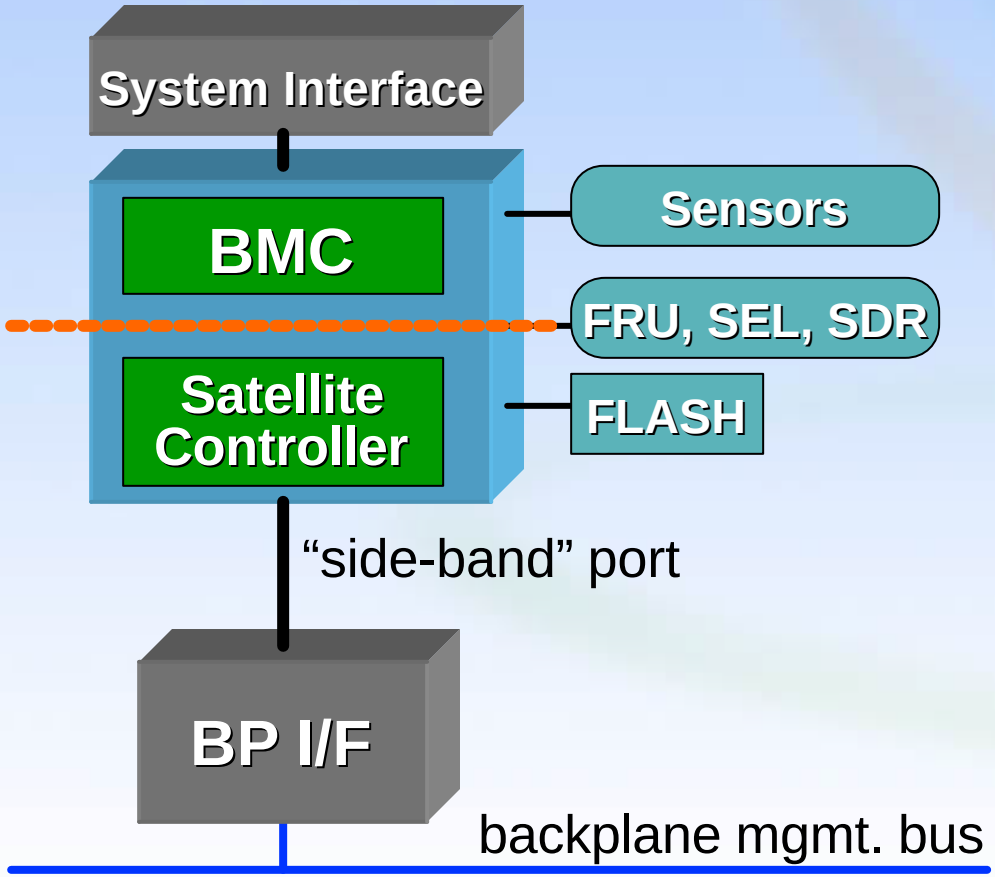
Firmware Firewall

Partitioning for protection

- **Problem: Bus topology enables local mgmt s/w to access other nodes**
- **Solution: "firmware firewall"**



Firmware Firewall



- F/W blocks messaging to other nodes on shared bus
- Allows messages between local software and management module
- Local software may also be blocked from SDR or FRU updates that might be used to generate false events
- Firmware updates can only occur from management bus side
- Access rights can only be configured from management bus side

Firmware Firewall

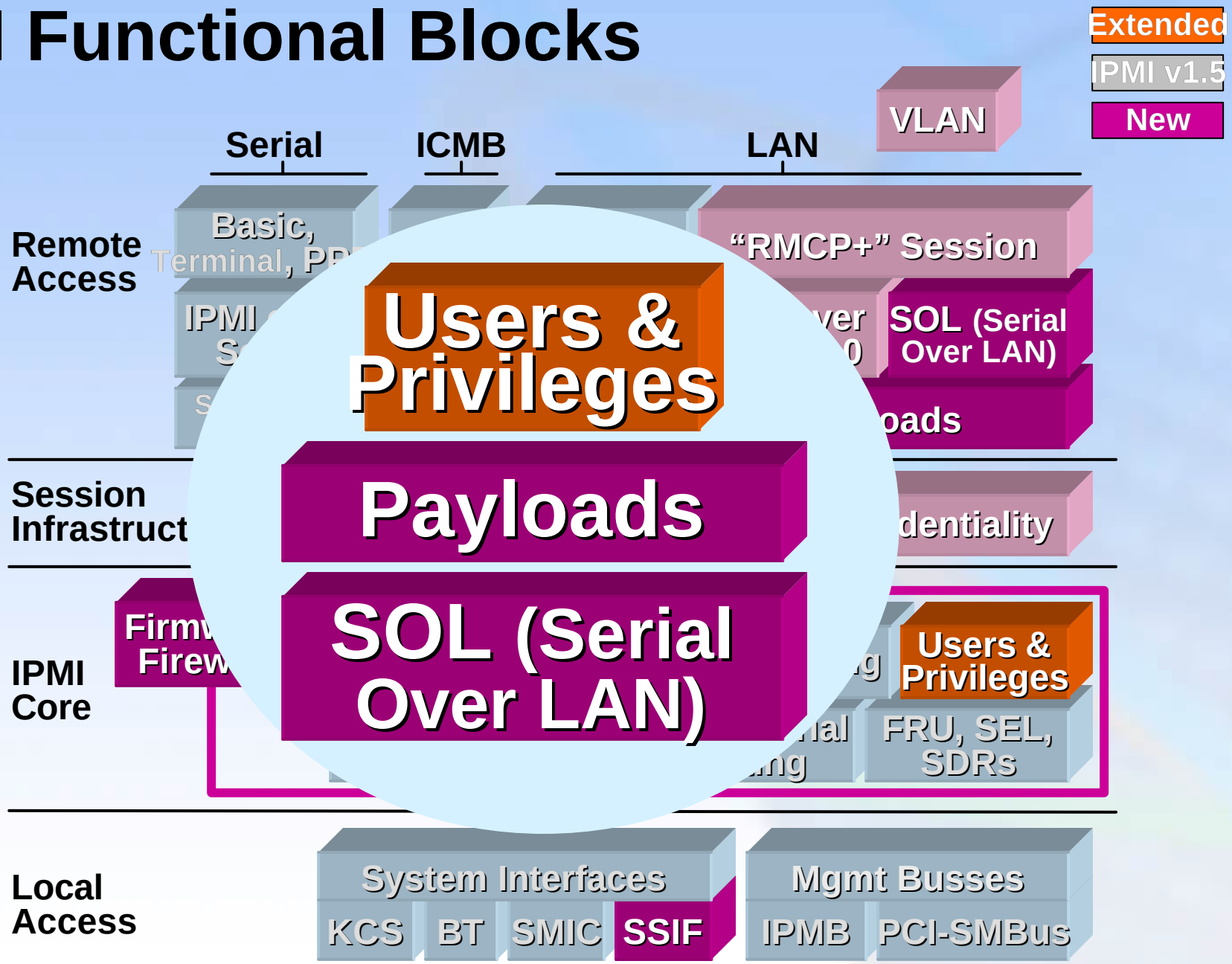
- ***Configurable Command Discovery*** **commands**
  - **Support discovering which commands and sub-functions can be enabled/disabled**
  - **Two commands:** ***Get Configurable Commands, Get Configurable Command Sub-functions***
- ***Command Configuration*** **commands**
  - **Provide mechanism for enabling/disabling those commands**
  - **Four commands:** ***Set/Get Command Enables, Set/Get Command Sub-function Enables***

Firmware Firewall

Command Discovery commands

- Enable software to discover what commands and subfunctions are available on given mgmt. controller
- Discovery commands can be implemented separate from Firmware Firewall enable/disable commands
- Centralize command and sub-function discovery
  - Augments IPMI distributed parameter, and 'try command' discovery
  - Command and sub-function support can vary on a PER CHANNEL basis
- Three commands: *Get NetFn Support*, *Get Command Support*, *Get Command Sub-function Support*

IPMI Functional Blocks



Users & Privileges

- **Per Channel Multi-level, Multi-User Security**
  - **User, Operator, Admin and OEM Privilege levels for IPMI commands**
  - **Per-user configurable enables for payload access (e.g. SOL)**
- **IPMI v2.0 Login Options**
  - **'Anonymous' login: no username or password required**
    - Can be enabled for a given privilege level. E.g. "User Level"
  - **Role-based login: password only, no username, for a given privilege level**
    - E.g. "Admin" login
  - **Username login: user name and user password required**
  - **'Two key' login: user/role password plus 'BMC Key'**
    - Can prevent multiple system access by 'human engineering' a single username/password pair.

Flexible configuration enables security to be tailored to site needs

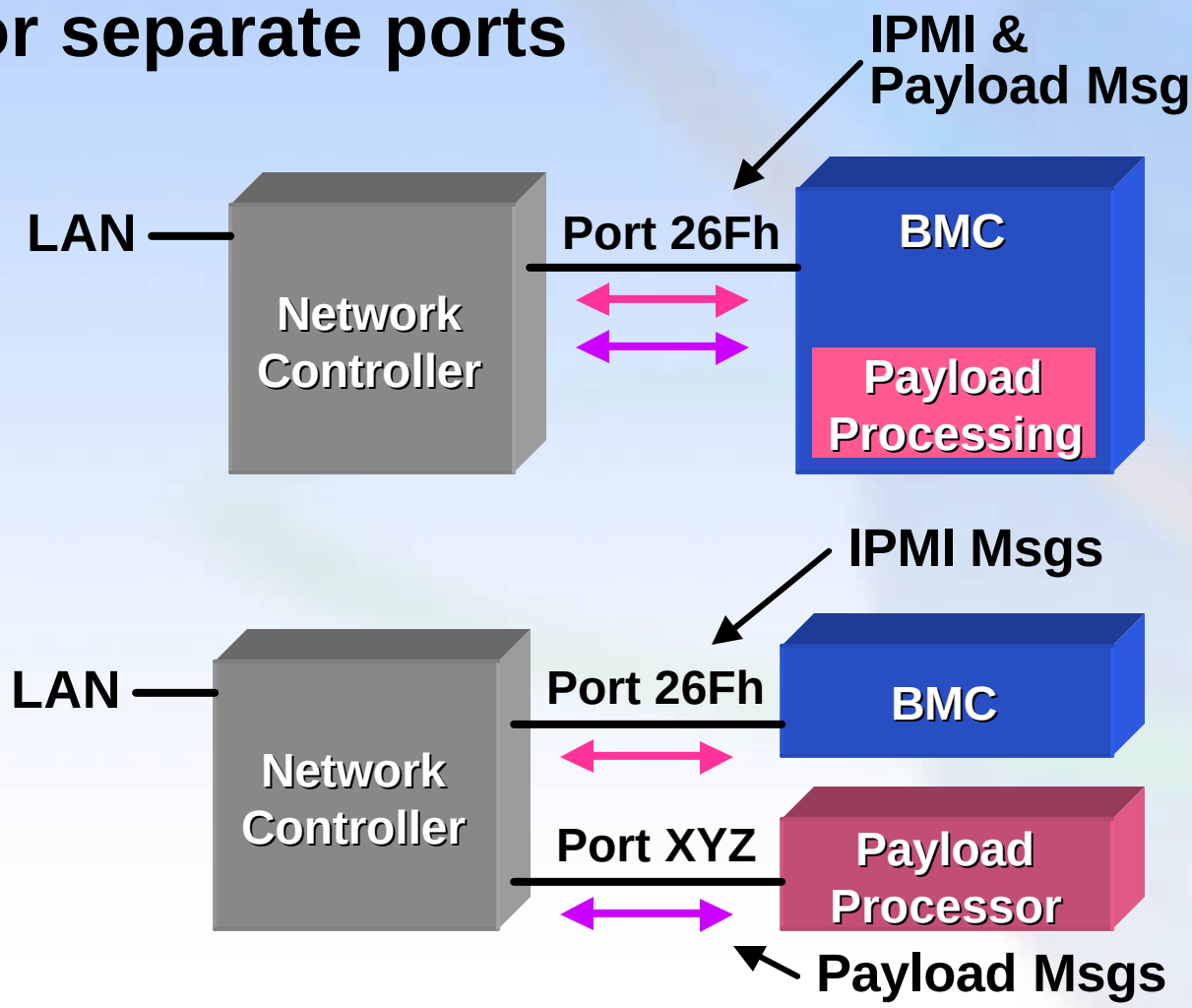
Payloads

- **Payloads enable multiple types of traffic to be carried over a single IPMI session**
  - **payloads can also be launched to a separate session**
- **Standard and OEM Payload Types supported**
  - **Standard payload types: Support Session Setup, IPMI Messages, "Serial Over LAN"**
  - **OEM payload types: Enable value-added features on IPMI session infrastructure (e.g. KVM)**
    - **Leverages IPMI User configuration and authentication**
- **Payload support is discoverable**
- **Payload access enabled on a per-user basis**

Session Payloads Enable "1-port" Management

Payloads

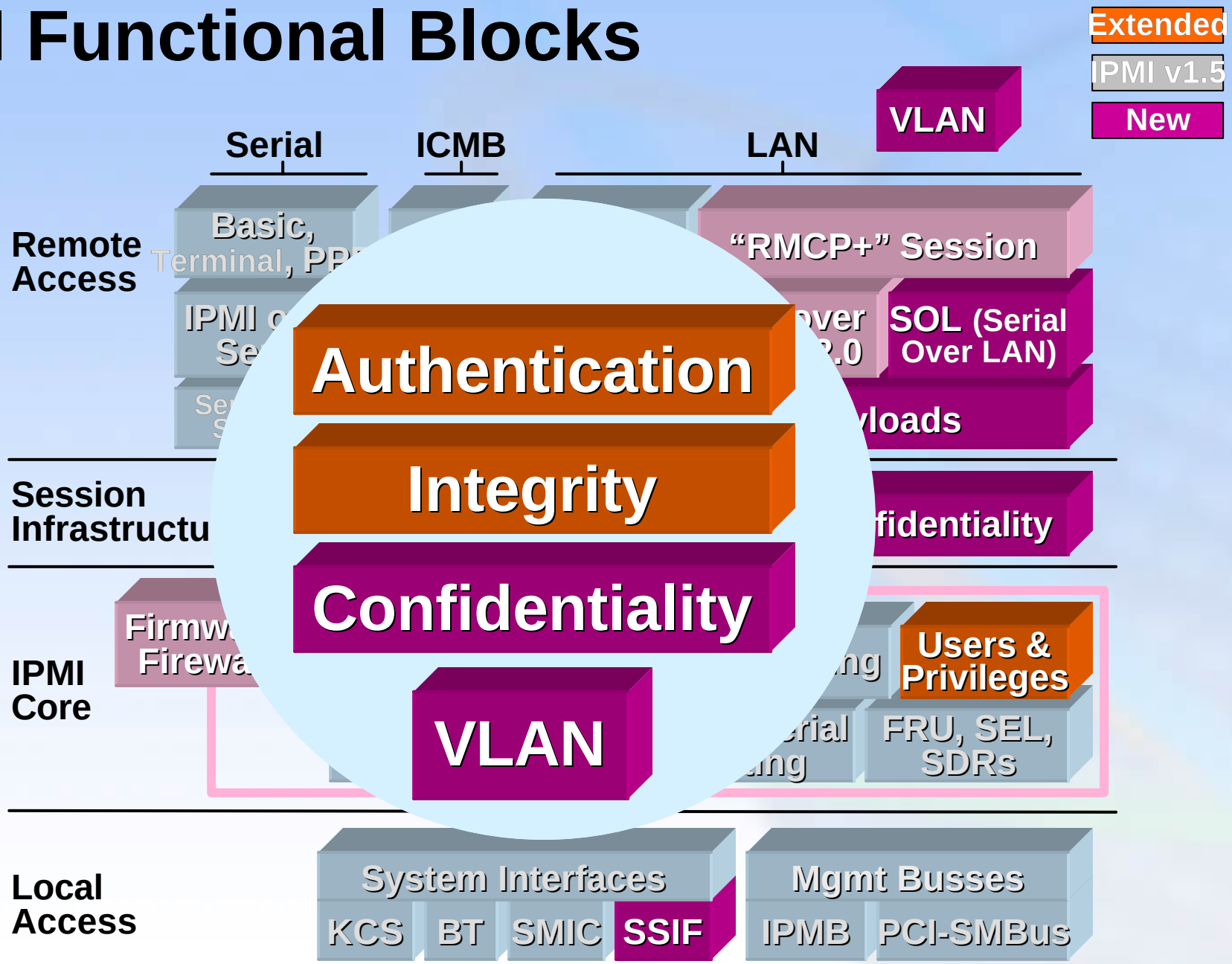
Payloads can be activated under common or separate ports



Serial Over LAN

- Defines common format and protocol for seria redirection under an IPMI Session
  - Redirects baseboard “16550” serial controller interface over LAN
  - Launched as a standard payload type under IPMI v2.0 Session
- Specification supports multiple serial connections
- Can be combined with IPMI Serial Port Sharing
  - Enables single ‘back of the box’ serial connection to be shared for local serial/modem, BMC access, and LAN redirected management

IPMI Functional Blocks



Authentication, Integrity, and Confidentiality

- **Authentication Algorithm:** Defines what steps are used for authenticating a User and establishing a session
  - **E.g. IPMI v2.0 uses for RAKP (remote access key exchange protocol)**
- **Integrity Algorithm:** Defines algorithm for signing packets after session has been established.
  - **E.g. HMAC-SHA1-96**
- **Confidentiality (encryption) Algorithm:** Defines algorithm for encrypted payload data in a session.
  - **E.g. AES-128 (Advanced Encryption Standard)**
- **Combination of Authentication, Integrity, and Encryption algorithms defines a CipherSuite**
- **Standard CipherSuites** provide algorithm to trade-off between strength and performance
- **OEM CipherSuites** also supported

Encrypted and Authenticated Packets

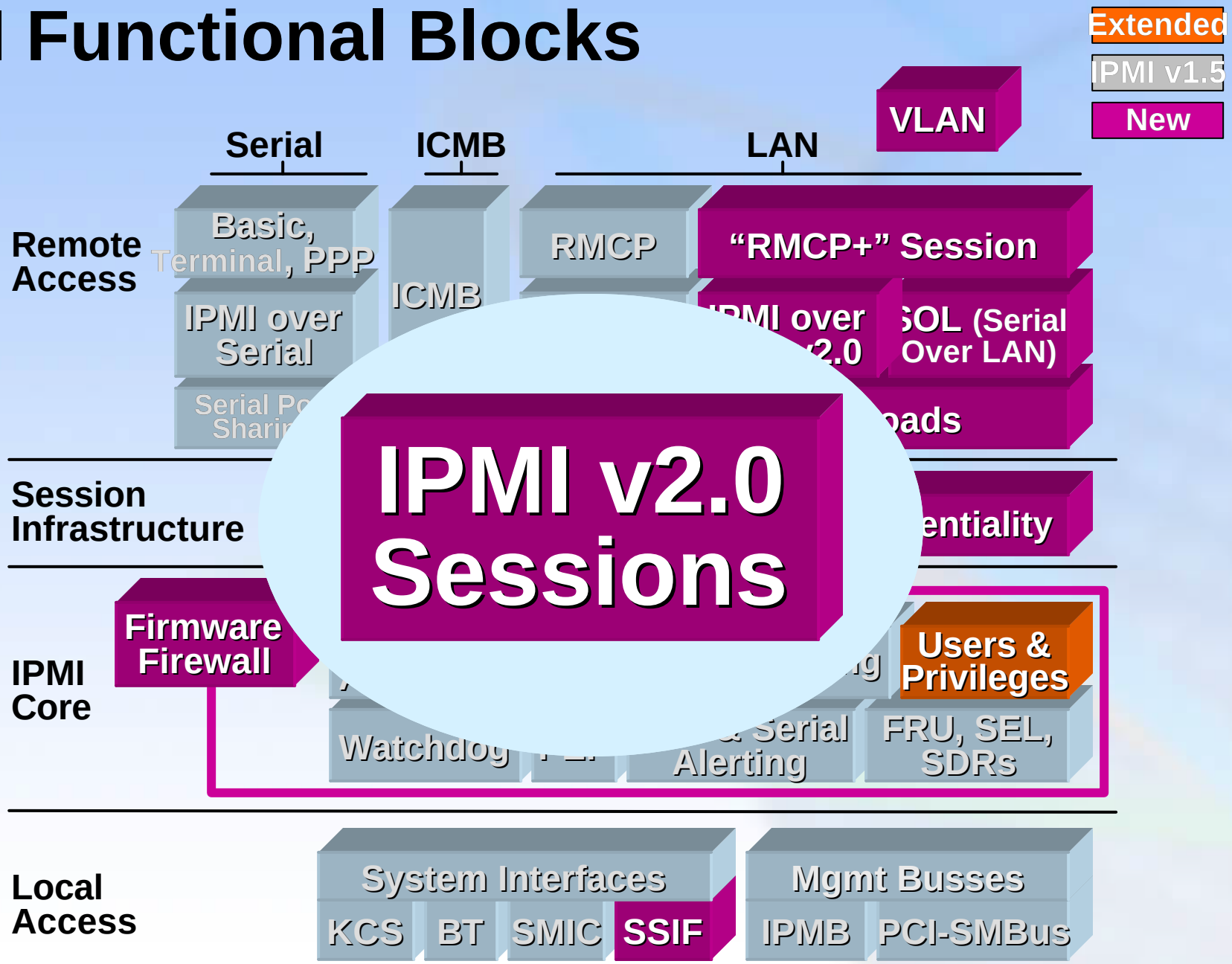
- **Authenticated / Unauthenticated and Encrypted / Unencrypted packets can be mixed in single session**
  - Improves performance on small micros. Bits in payload type field indicate whether the payload data is authenticated and /or encrypted
- **Remote console can be given option to control when payload data is encrypted**
  - Allows console to decide when an operation, e.g. remote password configuration, requires encryption
  - For IPMI messages, an encrypted request gets an encrypted response
  - For other payloads, a *Suspend/Resume Encryption* command is used
- **Can configure BMC to *require* that payload is encrypted.**
  - Prevents mis-behaved console from exposing sensitive data.

IPMI v2.0 technology reduces overhead for secure remote management

VLAN

- IPMI v2.0 LAN Packet format extended for “Virtual LAN” routing per IEEE 802.1q
- Works with side-band filtering in enhanced management network controllers
- VLAN support configurable on a per-channel basis

IPMI Functional Blocks



Sessions

Discovery and Connection

- **Enhanced User Login Options**
  - New option for ‘Role-only’ logins
  - Simplifies use in small installations
    - no username to remember, can simply login in as User, Operator, or Admin
- **New commands for managed system discovery**
  - Facilitates automated discovery and access by remote applications
  - IPMI version (v1.5 or v2.0) discovery
  - Cipher-Suite discovery
  - Available Payloads
  - Existence of Anonymous and One- or Two-key login
    - enables remote console to present appropriate username and password entry options

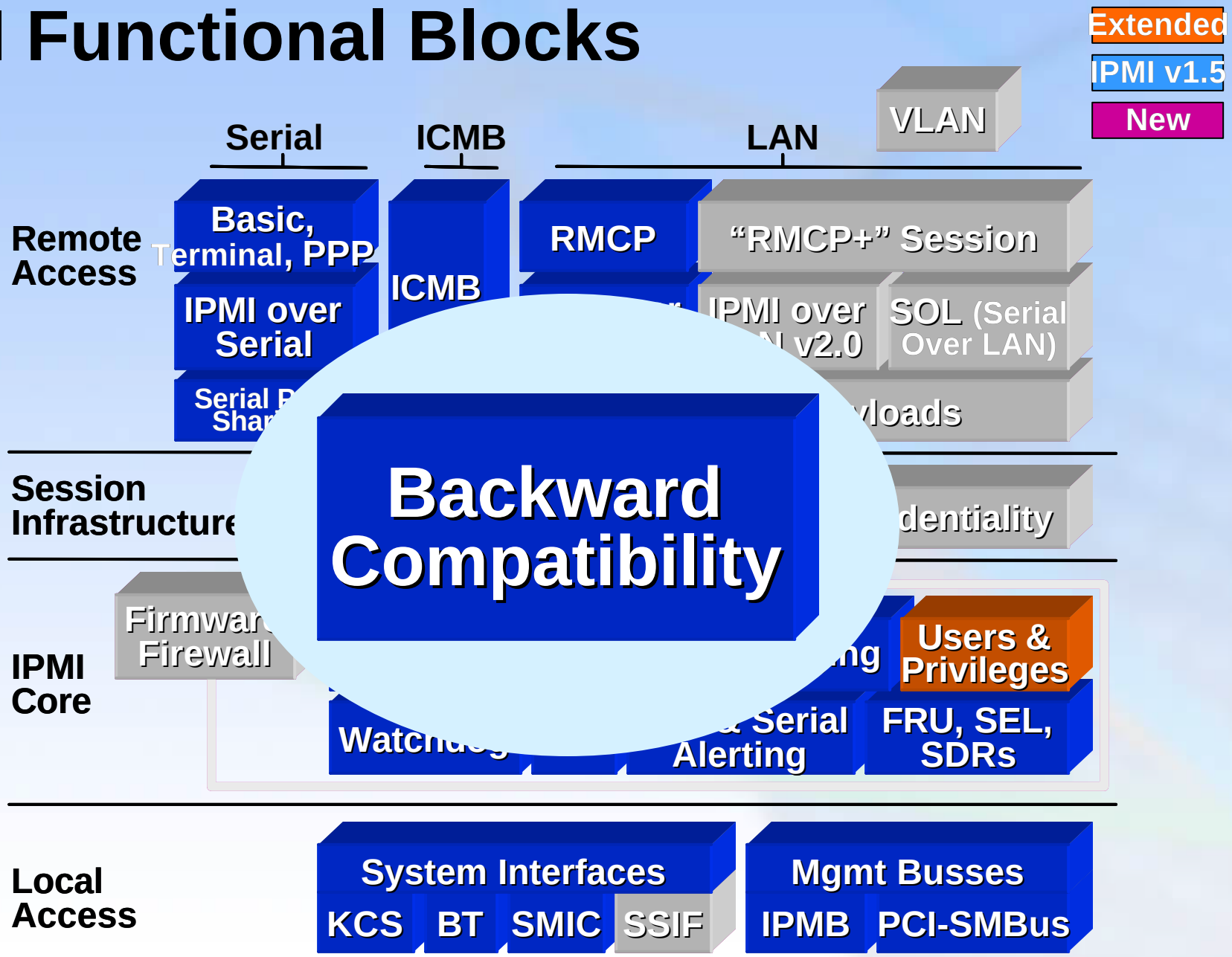
v2.0 Session Activation

- Discover IPMI support using *Get Channel Authentication Capabilities* command
  - Enables discovering IPMI version
  - Tells console whether 'anonymous' and/or '1-key' logins are enabled
  - Same command for v1.5 and v2.0
- Issue *Get Cipher Suites* command
  - Pick cipher suite for the maximum privilege level you want to establish the session at
- Activate session for given user…
  - IPMI v2.0 Uses dual Challenge/Response vs. IPMI v1.5 single challenge / response

v2.0 Session Activation

- Send *Open Session Request*
  Get *Open Session Response*
  - Sets session IDs and negotiates a ciphersuite
- Send *RAKP 1 Message*
  Get *RAKP 2 Message* as Response
  - Submits username and target privilege level to BMC
  - Exchanges random numbers between console and BMC
  - Roughly equivalent to the console submitting a challenge to the BMC and the BMC submitting a challenge to the console.
- Issue *RAKP 3 Message*, Get *RAKP 4 Message* as Response
  - BMC and Console exchanged 'signed' RAKP 3 and RAKP 4 packets
  - Signature based on the random numbers and key data associated with the user
  - Session is activated when both parties verify the signed packets.

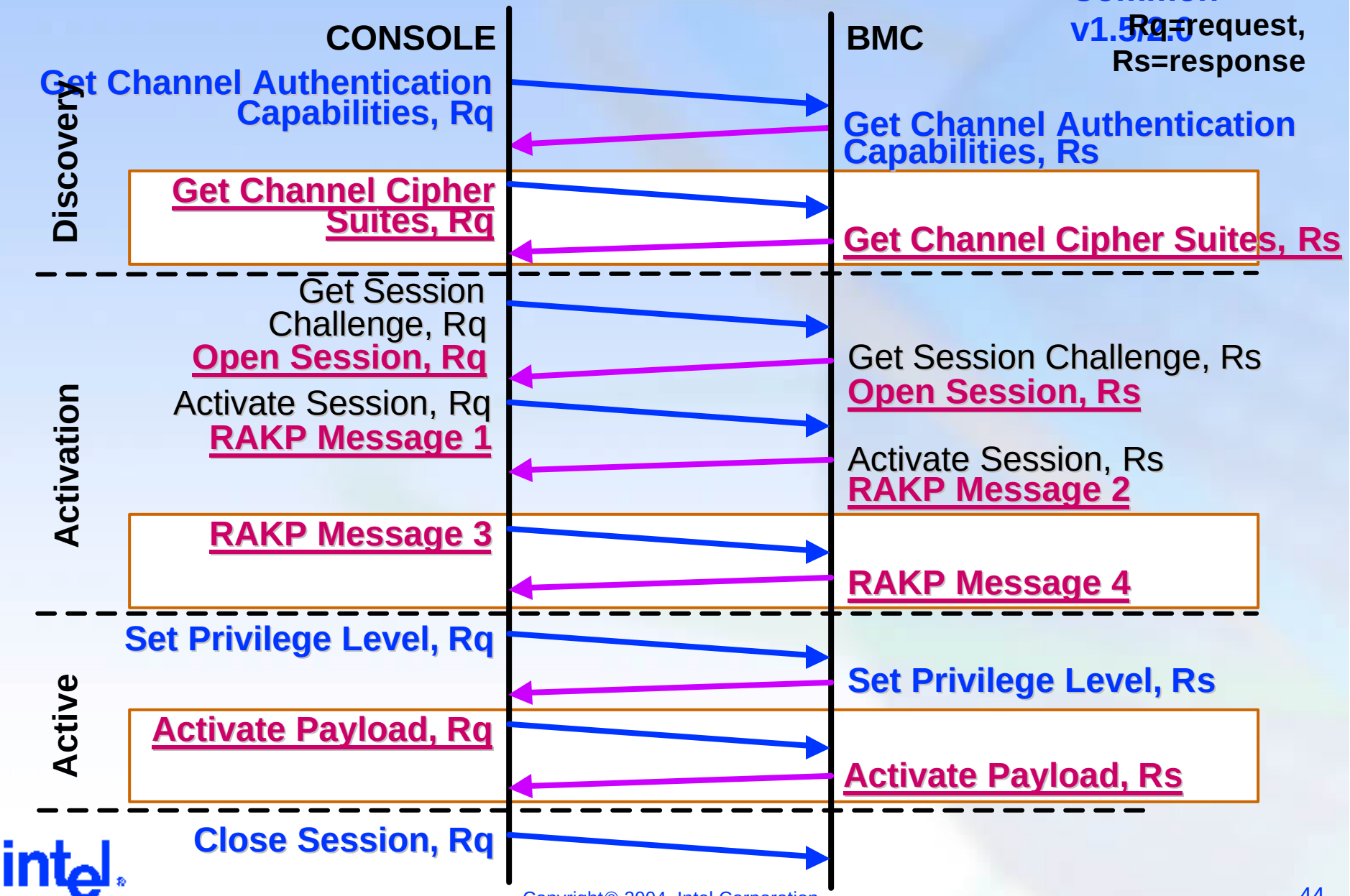
IPMI Functional Blocks



Backward Compatibility

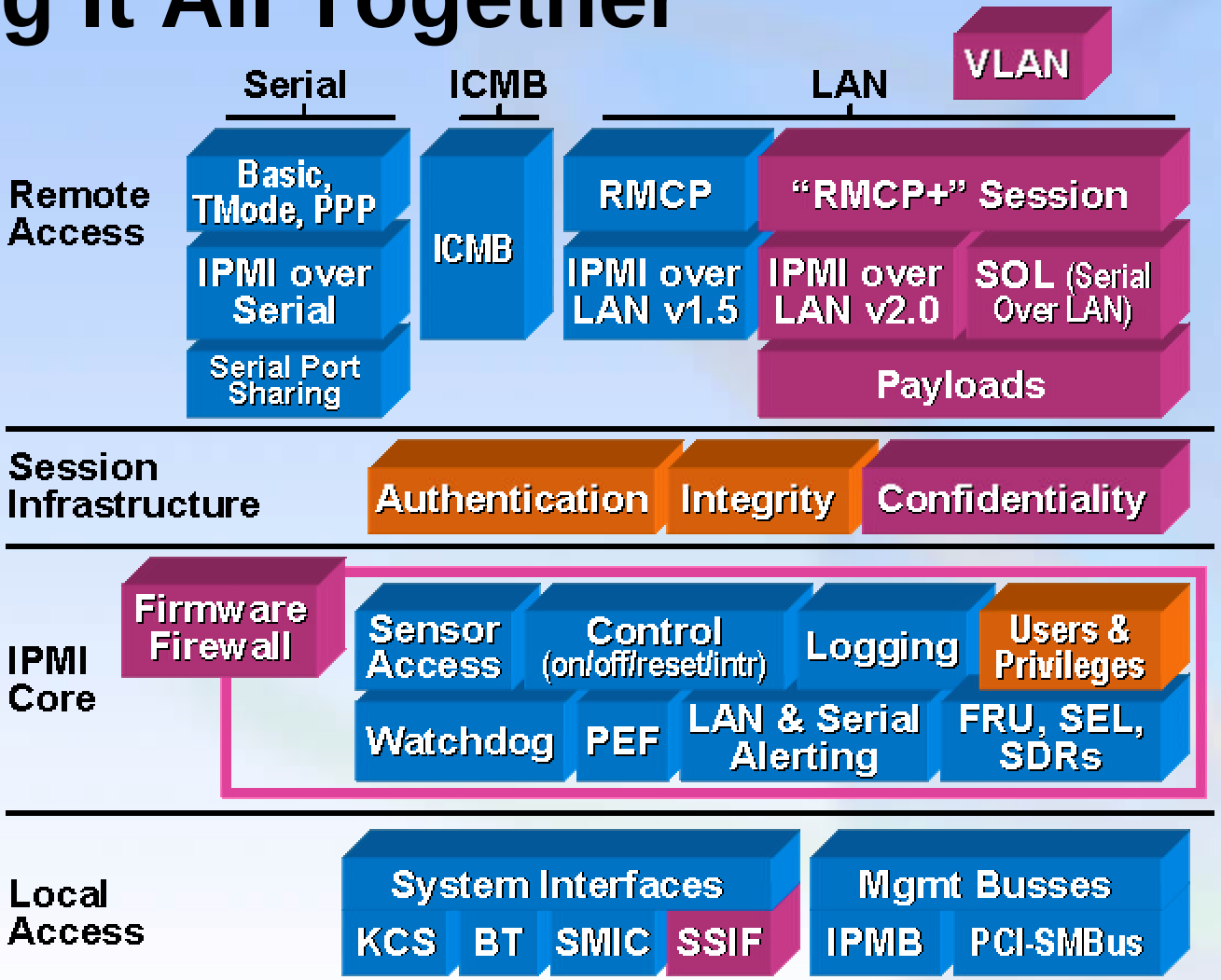
- Compatible command superset
  - Extends but does not replace IPMI v1.5 commands
- Managed systems can be discovered and used as an IPMI v1.5 system
  - Implementation can support both IPMI v2.0 and IPMI v1.5 connections simultaneously
  - Supports connecting using IPMI v1.5 protocols
    - IPMI v1.5 LAN packet support retained
- V2.0 packets/protocols required for new LAN features
  - e.g. enhanced auth., encryption, Serial Over LAN

IPMI Session Activation



Putting It All Together

Extended
IPMI v1.5
New



IPMI v2.0 technology enables secure remote management

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IPMI in HP's Integrity Servers


Integrity rx2600


Integrity rx4640


Integrity rx7620


Integrity rx8620


Integrity Superdome

- As one of IPMI's founding companies - HP has a long history of building industry standards around manageability.
- HP's entire line of Integrity IPF servers use IPMI, from the smallest 2-way server to the largest Superdome.
- HP uses IPMI, along with other manageability standards like WBEM, to build interfaces that promote interoperability between OS's and platforms.

IPMI is Highly Scalable

hp invent

Intel Developer Forum

HP: Enabling customer features

- IPMI fits well into the ecosystem of HP's value-added embedded management, covering some of the most basic functionality in a standard way
  - OS absent server health and server power control
  - Storage and retrieval of system event logs
  - A standard messaging mechanism for use with HP agents on Windows, HPUX, and Linux
- Upon this foundation, HP builds more features, to further enhance the manageability solution
  - Independent management LAN with secure (https) web interface or convenient Telnet UI to the management processor
  - Embedded web console
  - Enhanced event logging and diagnosis
  - Unique collaboration and repair features
  - Partition management, and more…

IPMI Supports Value Added Features

IPMI In Action

Dell Computer

"Standards simplify the computing environment and establish a common hardware and software platform, make it easier for systems to work together and to exchange information. Standards also simplify product development and service, thereby reducing our costs."

Michael Dell

- **Dell and IPMI**
  - Dell a founding IPMI Promoter
  - IPMI a core management technology for today's Dell PowerEdge servers
- **IPMI benefits for Dell Customers**
  - Helps lower server acquisition, training and operations costs
  - Enhances server availability
  - Enables server management with common tools and processes
- **IPMI 2.0 extends these benefits**
  - Enhances IPMI management security
  - Extends administrators reach with serial-over-LAN operations
  - Demonstrates industry focus on driving management standards

IPMI Delivers Common Management Interfaces

IPMI In Action

Dell PowerEdge™ 3250:

An IPMI Manageable Standards-Based Server

A cost effective, scalable solution for compute intensive applications utilizing Itanium Processor Family and standards-based manageability

- **Standards-based manageability for high performance computing**
  - **IPMI 1.5 server management**
  - **SMART drive monitoring**
  - **DMTF SMBIOS and ASF alerting**
- **Pro-active management for the scalable enterprise**
  - **Centralized operations enabled with IPMI monitoring and alerting**
  - **Remote control and recovery functions through IPMI server control, remote consoling**
  - **Large-scale remote operations via IPMI command-line interface**

DELL **IPMI Supports "Real Server" Management** Intel Developer Forum

IPMI In Action

Intel Corporation

- One of the Founding Companies for IPMI
- Over 5 years of IPMI-based Management for Server Building Blocks
  - In pedestal, rack, and modular (blade) chassis
  - In Entry through Enterprise
  - With Itanium®, Xeon™, and IA-32 processors
  - In General Purpose and Telco systems
  - Small business to Data Center

IPMI Works Across System Classes

Intel Corporation

- Over 7 product generations
- Over 5 different processors used for BMCs
  - some large systems have had as many as four management controllers
- Use IPMI SDRs to tailor server building blocks to customer
- Implementations take advantage of Intel processor and chipset management features
  - E.g. Memory and Bus Correctable and Uncorrectable error status, power state information, temperature and throttling status, etc.

IPMI Is Proven Technology

- Abit Computer Corp.
- Acer Inc.
- Adtron
- Amphus Inc.
- Advanced Micro Devices, Inc
- Agilent Technologies GmbH
- Alberta Microelectronics
- Allion Computer Inc.
- American Megatrends Inc.
- Arima Computer Corp.
- Artesyn Communication Products, Inc.
- ASIS LTD.
- ASUSTek Computer, Inc.
- Aventail Corporation
- Avian Communications
- Avocent, Inc.
- Axil Computer, Inc.
- Blue Wave Systems
- Bull S.A.
- C&D Technologies, Inc.
- California Digital Corp.
- Celestica
- C-MAC Engineering
- ColoWATCH, Inc
- Communication Automation Corporation
- Compellent Technologies, Inc.
- Concurrent Technologies, PLC
- CyberGuard Corporation
- Cyclades Corporation
- Data General Corporation
- Decru, Inc.
- Dell Computer Corporation
- Demac Associates
- Digi International
- Egenera, Inc.
- ElanVital Corporation
- Ericsson UAB
- ESO Technologies
- Evans & Sutherland
- Eversys Corporation
- Exabyte Corporation
- Extreme Engineering Solutions, Inc.
- Fabric7 Systems, Inc.
- First International Computer, Inc.
- FORCE Computers GmbH
- Forward Technologies
- Flextel SpA
- Freedom Technologies Corp.
- FreeIPMI Core Team
- Fujitsu, Ltd.
- Fujitsu Siemens Computers
- GoAhead Software, Inc.
- Gluon Networks, Inc
- HADCO Corporation
- HCL Infosystems Ltd.
- Hewlett-Packard Company
- Hewlett-Packard GmbH
- Hitachi Ltd.
- Hybricon Corporation
- IBM
- Ibus/Phoenix Corporation
- InnoMediaLogic, Inc.
- Integra Micro Sys. (P) Ltd.
- Intel Corporation
- Interphase Corporation
- InterWorks Computer Products
- Inventec Corporation
- Ipex ITG
- JMC Products
- Kealia, Inc
- Kaparel Corporation
- L-3 Communications Corp.
- LANDesk Software
- LANTRONIX
- Legend (Beijing) Limited
- LeoStream Corp.
- Linux NetworX, Inc.
- Lynux Works, Inc.
- Macrolink, Inc.
- Magnetek, Inc.
- MEGWARE Computer GmbH
- Mercury Computer Systems, Inc.
- Micro-Star International
- Mirapoint, Inc.
- MiTAC International Corp.
- Mitsubishi Electric Corp. Info. Systems Engineering Ctr.
- Motorola Computer Group
- National Semiconductor Corp.
- NEC Corporation
- Nematron Corporation Network Appliance, Inc.
- Network Engines, Inc.
- Network Storage Solutions, Inc.
- NEWISYS, Inc.
- NOCpulse, Inc.
- OliData S.p.A.
- Olivetti Computers Worldwide
- OSA Technologies
- Open Source Development Lab
- PEP Modular Computers
- Performance Technologies, Inc.
- PetaStream Inc.
- PFU Limited
- Phoenix Technologies Ltd.
- Pigeon Point Systems
- Pinnacle Data Systems, Inc.
- Praim, Inc.
- Qlogic Corporation
- Quanta Computer Inc.
- Radisys Corporation
- RADVISION
- RAMIX Inc.
- Raritan Computer, Inc.
- Reliance Computer Corp.
- Samsung Electronics Co., Inc.
- Sanera Systems, Inc.
- SANgate Systems, Inc.
- Sanritz Automation Co., Ltd.
- SBS Technologies (Industrial Computers GmbH)
- Scenix Semiconductor, Inc.
- Siemens AG
- Silicon Graphics, Inc.
- SKY Computers, Inc.
- SMIS R&D, Inc.
- Snap Appliance
- Stan Cox and Associates
- Standard Microsystems Corp.
- Stratalight Communications, Inc.
- Stratus Computer Systems Ireland Ltd.
- Summit Microelectronics, Inc.
- Sun Microsystems
- Super Micro Computer, Inc.
- SyAM Software
- Symphony Group Intl. Co., Ltd.
- Synergy Microsystems
- Technobox, inc
- Teknor Applicom, Inc.
- T-Netix, Inc.
- Tatung Co.
- Tektronix
- Texas Micro Corporation
- Togabi Technologies, Inc.
- Toshiba Corporation
- Trilogic Systems, LLC
- Trimm Technologies
- Tyan Computer Corporation
- Universal Scientific Industrial Corp.
- USAR Systems, Inc.
- Vitesse Semiconductor Corp.
- Watrin System Design
- Wyselec
- VIA Technologies, Inc.
- Vividon, Inc.
- Vooha, Inc.
- Winbond Electronics Corp.
- WIPRO Infotech
- Xiotech Corporation
- Ziatech Corporation
- ZNYX Networks, Inc.

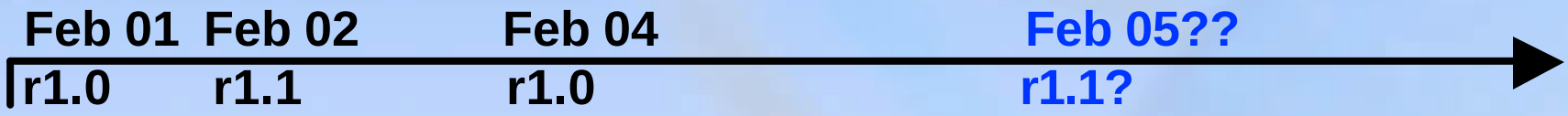
IPMI Technology is Widely Supported

Agenda

- IPMI Architecture and Initiative Update
- What's New in IPMI v2.0?
- IPMI v2.0 Technology: How IPMI v2.0 meets platform management needs
- IPMI in Action
- IPMI Futures

IPMI Futures

Advancing Platform Management



IPMI v1.5

- Monitoring (temp, volt, fan, etc.)
- Control (power on/off/cycle, reset, diag. interrupt)
- System Event Logging
- FRU & SDR Information
- Watchdog Timer
- Serial and LAN access
- Serial and LAN alerts
- Platform Event Filtering
- Serial Port Sharing
- Management busses

v2.0 Additions

- Session and Security Enhancements
- Serial Over LAN
- SSIF
- Alignment with ASF Authentication
- Encryption support
- Firmware Firewall
- Command Discovery
- Modular (blade) support

v2.0+ …

- New Payload Types
- Enh…
- …faces
- Links to Dire… based Authen…
- Impro… Group Control
- Auxili… og Acce…
- Integration with Web Interfaces
- Web services-based …

Proven Foundation for New Platform Management Features

New Capabilities Under Consideration

- Additional redirection payloads:
  - e.g. KVM, USB-media
- Improved configuration interfaces
  - Simplified save/restore of configuration settings
  - Secure migration of user configuration
  - Integration with configuration of 'Alternative Access' features, e.g. Web Server, Telnet
- Interfaces to Directory-based authentication
- More efficient options for 'group control'
  - E.g. option for 'persistent' connections

New Capabilities Under Consideration

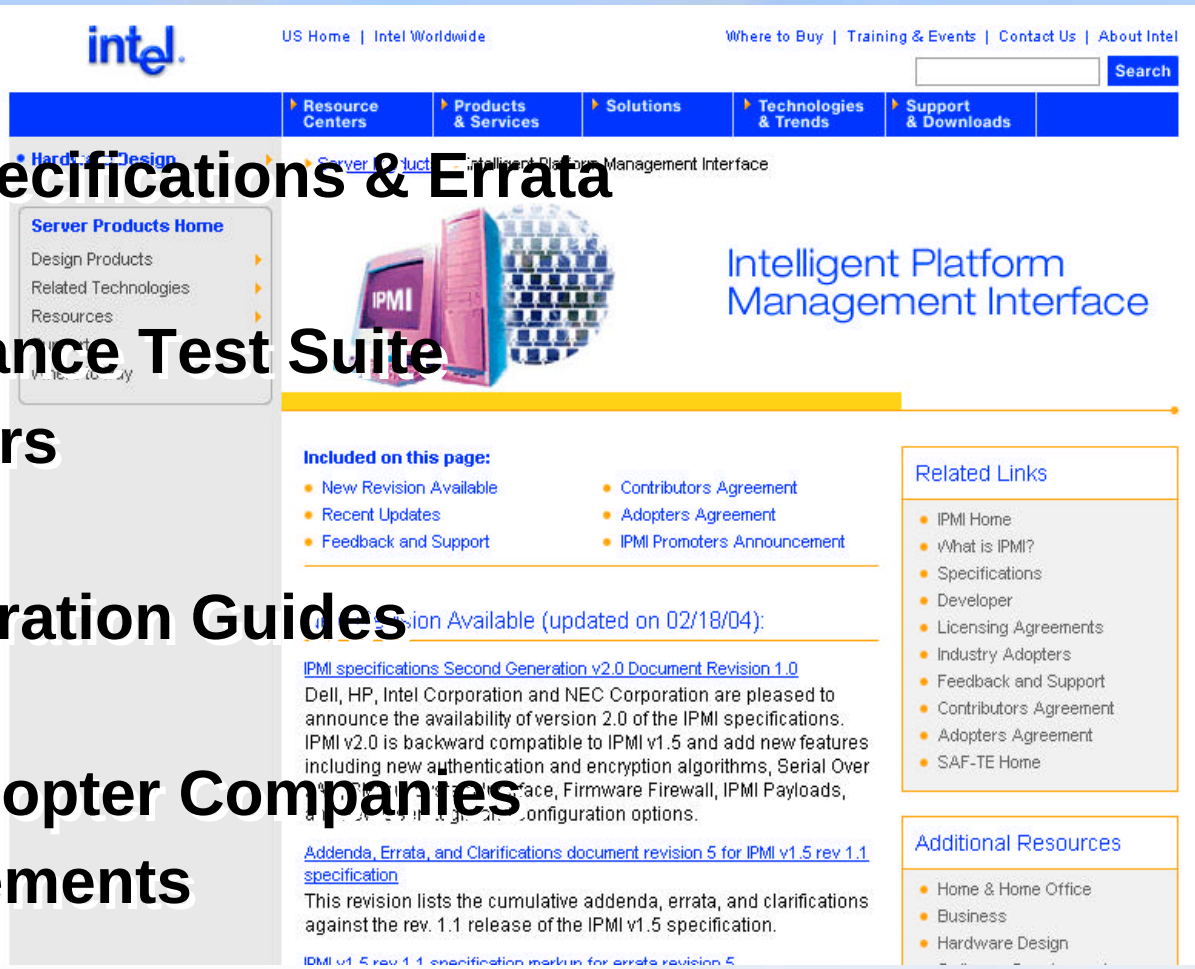
- Auxiliary Log access
- OOB configuration integration with web-based interfaces
  - enabling/disabling web server, CLI, Telnet
  - Configuring user privileges associated with secured interfaces
  - Integration with directory-based authentication
- Web-services –based interfaces
  - Alignment with “CIM+” / DMTF SMWG
  - “IPMI over XML/SOAP”

IPMI will continue to evolve with valuable new capabilities

Where to get More Info

IPMI Web Site

- Latest IPMI Specifications & Errata
- Presentations
- IPMI Conformance Test Suite
- Example Drivers
- Tools
- FAQ and Integration Guides
- Mailing List
- List of IPMI Adopter Companies
- Adopter Agreements



developer.intel.com/design/servers/ipmi

Summary

- IPMI reduces TTM and development cost for platform management
- IPMI v2.0 enables cross-platform manageability across server classes
- IPMI v2.0 technology enables secure remote management
- IPMI v2.0 technology is widely supported
- IPMI will continue to evolve with valuable new capabilities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Backup Slides

SSIF - SMBus System Interface

Operation	SMBus CMD	SMBus Protocol
BMC Single Part Write	**0x02**	**Write Block**
BMC Multi-Part Write - Start – first part	**0x06**	**Write Block**
- Middle part(s) if any	**0x07**	**Write Block**
- End – last part	**0x08**	**Write Block**
BMC Single Part Read	**0x03**	**Read Block**
BMC Multi-Part Read - Start – first part	**0x03**	**Read Block**, first two data bytes after length = [0x01,0x00]
- Middle part(s) if any	**0x09**	**Read Block**, first data byte after length = 0x00
- End – last part	**0x09**	**Read Block**, first data byte after length = 0x01

IPMI Functional Blocks